



A checklist of marine larval trematodes (Digenea) in molluscs from Argentina, Southwestern Atlantic coast

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Abstract: A checklist of cercariae parasitizing marine molluscs from Patagonian coast, Argentina, based on literature sources and new records here presented. In total, cercariae of 31 species of marine digeneans, including 11 new records here presented, are known to infect 20 species of molluscs (14 in nine gastropods species; 17 in 11 bivalve species). These records include two species of Aporocotylidae, four Bucephalidae, one Fellodistomidae, five Gymnophallidae, one Hemiuroidea, four Lepocreadiidae, two Microphallidae, five Monorchidae, one Notocotylidae, one Philophthalmidae, two Renicolidae, one Schistosomatidae and two Zoogonidae. For each digenean species, their hosts, habitat type, localities, infection site, prevalence, life cycle advances, and access numbers in helminthological collections and GenBank, when available, are detailed. Regarding the life cycles, eight were completely elucidated and four were partially elucidated. Moreover, there are molecular data for 15 species. The data here presented constitutes an advance in the parasites biodiversity knowledge and their life cycles.

Key words: parasites, bivalves, gastropods, diversity, cercariae, larvae, digenean

INTRODUCTION

The Patagonian Shelf extends for about 5,649 km along the Atlantic coast of South America from northern Uruguay (33°51' S, 053°11' W) to the southern tip of Argentina, bordering with Chile (54°55' S, 064°52' W). Its continental shelf is generally up to 100 m in depth, is the largest and one of the most productive ecosystems in the Southern Hemisphere (Miloslavich et al. 2011). In the Patagonian Shelf, two major marine currents coexist, the cold Malvinas and the warm Brazil currents. The Malvinas current originates in the Antarctic circumpolar current and carries a high nutrient load north along the Argentine coast. Biogeographically, the Patagonian Shelf is divided into two provinces, the Argentine and the Magellanic, that join around Peninsula Valdés. The

Argentine Biogeographic Province extends from 36° to 43°S and the Magellanic Biogeographic Province extends from 43° to 56°S (Miloslavich et al. 2011). The estimated mollusc species number is about 200 in the Argentine province and about 720 species in the Magellanic province (Bigatti and Penchaszadeh 2008). The great diversity of molluscs is given by the physiographic and climatic features of the Magellanic province, which is highly homogeneous and it has a lot of endemic taxa (Balech and Erlich 2008). Argentina's coast has mostly sandy beaches and some rocky formations. These rocky shores are dominated by two mussel species and by a diverse macroalgal community with an obvious tidal zonation.

Molluscs generally act as first intermediate hosts of digenean life cycles (Rohde 2005; Cremonte 2011) and their larval stages develop in the gonad and the digestive gland of them. The taxonomic identification of larval digenean is an important step towards the elucidation of their life cycles and the posterior use as a predictive tool in ecological studies (Nolan and Cribb 2005).

Lothar Szidat was largely responsible for inaugurating the study of marine helminthes in Argentina (Lunaschi et al. 2007). He recorded two bucephalid cercariae parasitizing the mussel *Brachidontes rodrigezi* (d'Orbigny) (Szidat 1963). Many freshwater cercariae (e.g., Ostrowski de Núñez 1974; Suriano and Martorelli 1983; Etchegoin et al. 1996; Martorelli and Etchegoin 1996; Martorelli et al., 2013) were recorded; however the knowledge about marine cercariae is scarce. Five isolated records were published by Ageitos de Castellanos (1961), Morris (1984), Martorelli (1991) and Szidat (1963, 1965). Since 2009 to date several advances in studies of cercariae from marine gastropods were done in Argentina by our research group. Despite the importance of digeneans in coastal marine areas, the data are scattered in literature and only 18 species of larval digenean in molluscs have been recorded (eight infecting six species of gastropods and 10 infecting six species of bivalves) in the Southwestern Atlantic coast. The aim of this study

is to present information and new data of occurrence of larval digenean found in the commonest gastropods and bivalves inhabiting coast from Argentina.

MATERIALS AND METHODS

A survey of the scientific data on larval digeneans found in marine molluscs from the Argentine coast was done through scientific papers between 1961 and 2014. Furthermore, we included new records from our research group. Specimens described by our research group were sampled during low tide on several occasions along different sites from the coast of Patagonia, Argentina. Molluscs were transported to the laboratory and placed in small flasks filled with seawater at room temperature (20–23°C). Emerged cercariae were studied alive, stained with neutral red or Nile blue under light microscope before being fixed. After 48 h, all molluscs were necropsied in order to detect prepatent infections and to study larval stages. The morphology was studied alive and photographed. Several naturally emerged cercariae were killed with heated seawater, immediately fixed with 10% formalin (Cribb and Bray 2010), stained with acetic carmine, dehydrated through ascendant ethanol series, cleared with methylsalicylate and mounted on glass slides with Canada balsam. Prevalences were calculated following Bush et al. (1997). Specimens of cercariae were deposited in the Parasitological Collection of Centro Nacional Patagónico (CONICET), Puerto Madryn, Chubut province, Argentina. A sample of cercariae specimens were preserved in ethanol 96% and frozen for molecular analyses. These analyses were performed on ribosomal DNA (mainly ITS1 e ITS2 regions) using standard techniques of DNA extraction, amplification by PCR and DNA sequencing (see protocols in Cremonte et al. 2013, 2015).

The taxonomy of digenean species is in accordance with Cable (1954, 1956, 1963), Holliman (1961), Yamaguti (1975) and Stunkard (1983). The taxonomic identity of the mollusc hosts were updated according to WoRMS (2015) and the species names were corroborated by malacological specialists. The marine cercaria species found in molluscs from Argentina are presented in alphabetic order for each family; each record contains information of the species name, authority and year, the name of mollusc host species, authority and family; the habitat where the respective life cycles of the digeneans occur (inter- or subtidal); the Argentine localities where of the molluscs were collected. Moreover, data related to prevalence of infection and life cycle were presented when it is available. If material deposited in helminthological collections or molecular sequences GenBank of other larval stages were available, the respective accession numbers were clarified between parentheses.

The acronyms for the Helminthological Collections are: Helminthological Collection of the Museo de La Plata (MLP), La Plata, Buenos Aires province, Argentina; National Parasitological Collection of the Museo Argentino de Ciencias Naturales “Bernardino Rivadavia” (MACN-Pa), Buenos Aires province, Argentina; Parasitological Collection of the Centro Nacional Patagónico (CNP-PAR), Puerto Madryn, Chubut province, Argentina.

The records were based on naturally infected molluscs. For most of the species listed in this study, cercariae emerge from the molluscs in aquatic environment; in other cases, when the life cycle is abbreviated, the information is provided in the section of the life cycle advances.

RESULTS

A total of 31 cercariae were identified infecting 20 species of molluscs, one at superfamily level, 14 at family level, 10 at genera level and six at species level. From 31 marine cercariae, 14 are infecting nine gastropods species and 17 are infecting 11 bivalve species. Figure 1 shows the localities where the cercariae were recorded.

Phylum Platyhelminthes Gegenbaur, 1859

Subphylum Neodermata (Ehlers, 1995)

Class Trematoda Rudolphi, 1808

Subclass Digenea Carus, 1863

Aporocotylidae Odhner, 1912

Aporocotylidae gen. et sp. 1

HOST: *Ensis macha* (Molina) (Bivalvia: Pharidae).

HABITAT: Sandy subtidal.

CERCARIAN GROUP: Furcocercous.

LOCALITY: La Tapera Beach, San José Gulf (42.33° S, 064.55° W), Chubut province.

INFECTION SITES: Gonad, digestive gland and gills.

PREVALENCE: 1/30 (3.3%).

MATERIAL DEPOSITED: CNP-PAR 59 (histological section).

REFERENCE: Vázquez et al. (2013).

Aporocotylidae gen. et sp. 2

HOST: *Amiantis purpurata* (Molina) (Bivalvia: Veneridae).

HABITAT: Sandy subtidal.

CERCARIAN GROUP: Furcocercous.

LOCALITY: El Molino Beach, San Matías Gulf (40.82° S, 064.73° W), Río Negro province.

INFECTION SITES: Gills and a kidney in high intensities of infection.

PREVALENCE: 3/690 (0.43%).

MATERIAL DEPOSITED: MLP 6288, 6289; CNP- Par 31, 32.

REFERENCE: Gilardoni et al. (2011b).

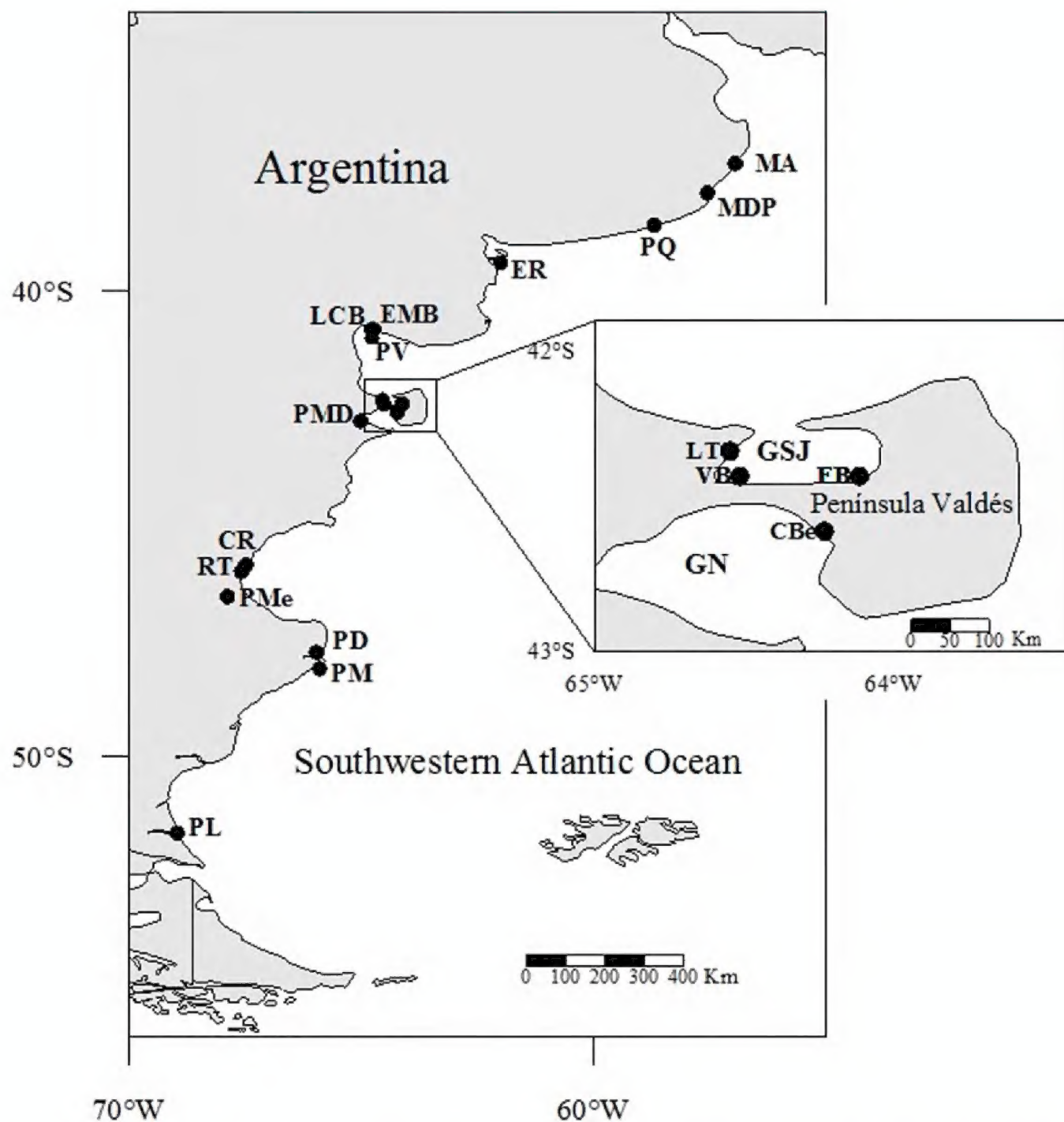


Figure 1. Map of localities where molluscs were found infected with marine larval digeneans in Argentina. Localities abbreviations: CBe, Colombo Beach; CR, Comodoro Rivadavia; EMB, El Molino Beach; ER, El Rincón; FB, Fracasso Beach; LCB, La Conchilla Beach; LT, La Tapera; MA, Mar Azul; MDP, Mar del Plata; PD, Puerto Deseado; PMD, Puerto Madryn; PQ, Puerto Quequén; PL, Punta Loyola; PM, Punta Maqueda; PMe, Punta Medanosa; PV, Punta Villarino; RT, Rada Tilly; VB, Villarino Beach.

Bucephalidae Poche, 1907

Bucephalidae gen. et sp. (New record)

HOSTS: *Mytilus edulis* (Linnaeus), *Perumytilus purpuratus* (Lamarck), *Aulacomya atra* (Molina) (Bivalvia: Mytilidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Gasterostome.

LOCALITIES: Puerto Madryn (PMD) (42.78° S, 065.02° W), Comodoro Rivadavia (CR) (45.87° S, 067.48° W), Chubut province.

INFECTION SITES: Gonad and digestive gland.

PREVALENCES: 1/15 (6.67%) (*M. edulis*) (CR), 16/151 (10.6%) (*P. purpuratus*) (CR, PMD), 1/15 (6.67%) (*A. atra*) (CR).

MATERIAL DEPOSITED: CNP-PAR 73 (PMD).

Bucephalus von Baer, 1827

Bucephalus sp. 1

HOST: *Brachidontes rodriguezii* (d'Orbigny) (Bivalvia: Mytilidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Gasterostome.

LOCALITIES: Puerto Quequén (PQ) (38.58° S, 058.70° W) and Mar del Plata (MDP) (37.88° S, 057.55° W), Buenos Aires province.

INFECTION SITES: Gonad, digestive gland and base gills.

PREVALENCE: 17/1398 (1.2%) (MDP).

MATERIAL DEPOSITED: CNP-PAR 72 (MDP).

REFERENCES: Szidat (1963), Morris (1984).

Bucephalus sp. 2

HOST: *Mytilus edulis* (Linnaeus) (Bivalvia: Mytilidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Gasterostome.

LOCALITIES: Mar del Plata (MDP) (37.88° S, 057.55° W), Puerto Quequén (PQ) (38.58° S, 058.70° W) and El Rincón (ER) (39.73° S, 60.83° W), Buenos Aires province.

INFECTION SITES: Gonad and digestive gland.

PREVALENCES: 4/650 (0.62%) (MDP), 39/1,089 (3.58%) (PQ), 5/262 (1.91%) (ER).

MATERIAL DEPOSITED: MACN-Pa 144 (1-7) (MDP);

CNP-PAR 68 (ER).

REFERENCES: Ageitos de Castellanos (1961), Szidat (1965), Morris (1984).

***Prosorhynchus* Odhner, 1905**

***Prosorhynchus* sp.**

HOST: *Brachidontes rodriguezii* (d'Orbigny) (Bivalvia: Mytilidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Gasterostome.

LOCALITIES: Puerto Quequén (PQ) (38.58° S, 058.70° W) and Mar del Plata (MDP) (37.88° S, 057.55° W), Buenos Aires province.

INFECTION SITES: Gonad, digestive gland and base gills.

PREVALENCE: 28/1000 (2.8%) (MDP).

MATERIAL DEPOSITED: MACN-Pa 145 (PQ); CNP-PAR 71 (MDP).

REFERENCES: Szidat (1963).

***Fellodistomidae* Nicoll, 1909**

***Monascus* Looss, 1907**

***Monascus filiformis* (Rudolphi, 1819)**

HOST: *Ennucula puelcha* (d'Orbigny) (Bivalvia: Nuculidae).

HABITAT: Sandy subtidal.

CERCARIAN GROUP: Furcocercous.

LOCALITY: Mar del Plata (37.88° S, 057.55° W), Buenos Aires province.

INFECTION SITES: Gonad and digestive gland.

PREVALENCE: 1/23 (4.35%).

LIFE CYCLE: Hydromedusae *Clytia* sp. (Campanulariidae), *Liriope tethraphyla* Chamisso & Eysenhardt (Geryoniidae), *Eucheilota ventricularis* McCrady (Lovenellidae), *Aglauroopsis kawari* Moreira & Yamashita (Olindiidae) and chaetognathe *Sagitta* sp. (Sagittidae) as second intermediate hosts; marine teleost fish *Trachurus lathami* Nichols (Carangidae) as definitive host.

MATERIAL DEPOSITED: CNP-PAR 67.

REFERENCES: Girola et al. (1992), Martorelli and Cremonte (1998).

***Gymnophallidae* Odhner, 1905**

***Gymnophallidae* gen. et sp. 1 (New record)**

HOST: *Lasaea adansoni* (Gmelin) (Bivalvia: Lasaeidae).

HABITAT: Among byssi of mytilids or among *Balanus* sp. (Balanidae) cirripedians, rocky intertidal.

CERCARIAN GROUP: Furcocercous.

LOCALITIES: Comodoro Rivadavia (CR) (45.87° S, 067.48° W), Chubut province and Puerto Deseado (PD) (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad, also in mantle, gills and nephridia in high intensities of infection.

PREVALENCES: 4/33 (12.5%) (CR), 6/517 (1.16%) (PD).

MATERIAL DEPOSITED: CNP- Par 45 (PD).

***Gymnophallidae* gen. et sp. 2 (New record)**

HOST: *Neolepton cobbi* (Cooper & Preston) (Bivalvia: Neoleptonidae).

HABITAT: Sandy intertidal.

CERCARIAN GROUP: Furcocercous.

LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITE: Gonad.

PREVALENCE: 1/142 (0.7%).

MATERIAL DEPOSITED: CNP- Par 46.

***Gymnophallidae* gen. et sp. 3 (New record)**

HOST: *Gaimardia trapesina* (Lamarck) (Bivalvia: Gaimardiidae).

HABITAT: On fronds of the giant kelp, *Macrocystis pyrifera* (Linnaeus) (Laminariaceae), shallow subtidal.

CERCARIAN GROUP: Furcocercous.

LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad and digestive gland.

PREVALENCE: 8/504 (1.59%).

MATERIAL DEPOSITED: CNP- Par 47.

***Bartolius* Cremonte, 2001**

***Bartolius pierreii* Cremonte, 2001**

HOST: *Darina solenoides* (King) (Bivalvia: Mactridae).

HABITAT: Sandy intertidal.

CERCARIAN GROUP: Furcocercous.

LOCALITY: Fracasso Beach, San José Gulf (42.42° S, 064.12° W), Chubut province.

INFECTION SITES: Gonad, digestive gland and kidney.

PREVALENCE: 3/60 (5%).

LIFE CYCLE: Same clam *D. solenoides* as second intermediate host (metacercaria encyst in the extrapallial cavity); kelp gull *Larus dominicanus* Lichtenstein (Laridae) and *Calidris canutus rufa* (Linnaeus) (Scolopacidae) as definitive hosts.

MATERIAL DEPOSITED: MLP 5020, 5064-5069; CNP-PAR 58 (cercaria), 1 (metacercaria), 12 (adult).

REFERENCES: Cremonte (2001), Cremonte (2004).

***Gymnophalloides* Fujita, 1925**

***Gymnophalloides nacellae* Cremonte, Pina, Gilardoni, Rodrigues, Chai & Ituarte, 2013**

HOST: *Gaimardia trapesina* (Lamarck) (Bivalvia: Gaimardiidae).

HABITAT: On fronds of the giant kelp *Macrocystis pyrifera* (Linnaeus) (Laminariaceae), shallow subtidal.

CERCARIAN GROUP: Furcocercous.

LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITE: Gonad and digestive gland.

PREVALENCE: 10/504 (1.98%).
 LIFE CYCLE ADVANCES: The gastropod *Nacella (Patinigera) magellanica* (Nacellidae) as second intermediate host.
 MATERIAL DEPOSITED: CNP-PAR 48 (cercaria), 50, 51 (metacercaria).
 GENBANK NUMBER: KF575168 (sporocyst), JN381025 (metacercaria) (ITS1).
 REFERENCES: Ituarte et al. (2005), Cremonte et al. (2013).

Hemiuroidea Looss, 1899

Hemiuroidea fam., gen. et sp.

HOST: *Siphonaria lessonii* Blainville (Gastropoda: Siphonariidae).
 HABITAT: Rocky intertidal.
 CERCARIAN GROUP: Cystophorous.
 LOCALITIES: Fracasso Beach (FB) (42.42° S, 064.12° W), Puerto Madryn (PMD) (42.78° S, 065.02° W), Comodoro Rivadavia (CR) (45.87° S, 067.48° W), Chubut province and Puerto Deseado (PD) (47.75° S, 065.97° W), Santa Cruz province.
 INFECTION SITES: Gonad, digestive gland, glandular complex associated with the mantle, connective tissue of mantle and secondary gill in high intensities of infection.
 PREVALENCES: 11/223 (5%) (PF), 5/1,050 (0.48%) (PDM), 6/500 (1.2%) – 50/500 (10%) (CR), 9/186 (4.84%) (PD).
 MATERIAL DEPOSITED: MLP 5738 (CR), CNP- Par 26 (PD).
 GENBANK NUMBER: KF451931 (sporocyst) (PMD) (ITS1).
 REFERENCES: Alda and Martorelli (2009), Gilardoni et al. (2011a).

Lepocreadiidae Odhner, 1905

Lepocreadiidae gen. et sp. 1 (New record)

HOST: *Crepidatella dilatata* (Lamarck) (Gastropoda: Calyptraeidae).
 HABITAT: Rocky intertidal.
 CERCARIAN GROUP: Ophthalmo trichocercous.
 LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.
 INFECTION SITES: Gonad and also digestive gland in high intensities of infection.
 PREVALENCE: 10/266 (3.76%).
 MATERIAL DEPOSITED: CNP-PAR 52.
 GENBANK NUMBER: KF451932, KF451933 (redia) (PD) (18S, ITS1, ITS2, 28S).

Lepocreadiidae gen. et sp. 2 (New record)

HOST: *Pareuthria plumbea* Philippi (Gastropoda: Buccinidae).
 HABITAT: Rocky intertidal.
 CERCARIAN GROUP: Ophthalmo trichocercous.
 LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad and also digestive gland in high intensities of infection.
 PREVALENCE: 16/458 (3.49%).
 MATERIAL DEPOSITED: CNP-PAR 53.
 GENBANK NUMBER: KF451934, KF451935 (redia) (18S, ITS1, ITS2, 28S).

Opechona Looss, 1907

Opechona sp. 1

HOST: *Buccinanops monilifer* (Kiener) (Gastropoda: Nassariidae).
 HABITAT: Sandy subtidal.
 CERCARIAN GROUP: Ophthalmo trichocercous.
 LOCALITY: Mar del Plata (37.88° S, 057.55° W), Buenos Aires province.
 INFECTION SITES: Gonad and digestive gland.
 LIFE CYCLE ADVANCES: Jellyfish, *Olindias sambaquiensis* Müller (Olindiidae) as second intermediate host.
 REFERENCE: Martorelli (1991).

Opechona sp. 2

HOST: *Buccinanops cochlidium* (Dillwyn) (Gastropoda: Nassariidae).
 HABITAT: Sandy subtidal.
 CERCARIAN GROUP: Ophthalmo trichocercous.
 LOCALITY: Villarino Beach, San José Gulf (42.42° S, 064.31° W), Chubut province.
 INFECTION SITES: Gonad and also digestive gland in high intensities of infection.
 PREVALENCE: 66/426 (15.5%).
 MATERIAL DEPOSITED: CNP-PAR 39.
 GENBANK NUMBER: KF451938, KF451939 (redia) (18S, ITS1, ITS2, 28S).
 REFERENCE: Averbuj and Cremonte (2010).

Microphallidae Travassos, 1920

Maritrema (Maritrema) Nicoll, 1907

Maritrema sp. 1

HOST: *Crepidatella dilatata* (Lamarck) (Gastropoda: Calyptraeidae).
 HABITAT: Rocky intertidal.
 CERCARIAN GROUP: Monostome xiphidiocercaria.
 LOCALITIES: Puerto Madryn (PMD) (42.78° S, 065.02° W), Chubut province and Puerto Deseado (PD) (47.75° S, 065.97° W), Santa Cruz province.
 INFECTION SITES: Gonad and digestive gland, also foot and mantle in high intensities of infection.
 PREVALENCES: 557/1,665 (33.45%) (PMD), 44/266 (16.5%) (PD).
 MATERIAL DEPOSITED: MLP 6285 (PMD), CNP-PAR 28 (PMD).
 GENBANK NUMBER: KCO12521 (sporocyst) (PMD) (ITS1, 5.8S, ITS2).
 REFERENCE: Gilardoni et al. (2011a).

***Maritrema madrynense* Diaz & Cremonte, 2010**

HOSTS: *Siphonaria lessonii* Blainville and *S. lateralis* Gould (Gastropoda: Siphonariidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Monostome xiphidiocercaria.

LOCALITIES: Fracasso Beach (FB) (42.42° S, 064.12° W), Puerto Madryn (PMD) (42.78° S, 065.02° W), Comodoro Rivadavia (CR) (45.87° S, 067.48° W), Rada Tilly (RT) (46.55° S, 067.88° W), Chubut province; Punta Maqueda (PM) (46.02° S, 067.58° W) and Puerto Deseado (PD) (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad and digestive gland, glandular pallial complex and gills in high intensities of infection.

PREVALENCES: 39/394 (10%) (FB), 94/1,050 (8.95%) (PMD), 34/500 (6.73%)-405/500 (81%) (CR, RT, PM), 17/423 (4.02%) (PD).

LIFE CYCLE: Same gastropod *S. lessonii* (metacercaria encyst inside sporocyst); crab *Cyrtograpsus altimanus* Rathbun (Crustacea) and isopod *Idothea baltica* (Pallas) (Crustacea) as second intermediate hosts; kelp gull *Larus dominicanus* Lichtenstein (Laridae) as definitive host.

MATERIAL DEPOSITED: MLP 5736, 6284 (CR, PM, RT); CNP-PAR 27 (cercaria), 74 (metacercaria) (PMD), 11 (adult) (FB).

GENBANK NUMBER: KC222022 (sporocyst), KC222023, KC222024 (metacercaria), KF575167 (adult) (PMD) (ITS1, 5.8S, ITS2).

REFERENCES: Alda and Martorelli (2009); Diaz and Cremonte (2010); Gilardoni et al. (2011a).

Monorchiidae Odhner, 1911

Monorchiidae gen. et sp. 1

HOST: *Amiantis purpurata* (Molina) (Gastropoda: Veneridae).

HABITAT: Sandy intertidal and subtidal.

CERCARIAN GROUP: Microcercous.

LOCALITIES: Mar Azul (MA) (37.25° S, 056.95° W), Buenos Aires province and Punta Villarino (PV) (40.83° S, 064.75° W) San Matías Gulf, Río Negro province.

INFECTION SITES: Gonad and digestive gland, also foot, mantle, gills and around intestine in high intensities of infection.

PREVALENCES: 16/17 (94.1%) (MA), 19/220 (8.8%) (PV).

MATERIAL DEPOSITED: MLP 4808, 4809 (cercariae and metacercariae) (PV), 4810 (sporocysts) (MA); CNP-PAR 69 (MA).

REFERENCE: Cremonte et al. (2001).

Monorchiidae gen. et sp. 2

HOST: *Amiantis purpurata* (Molina) (Bivalvia: Veneridae).

HABITAT: Sandy intertidal.

CERCARIAN GROUP: Ophthalmo-leptocerca.

LOCALITY: La Conchilla Beach (40.82° S, 064.78° W), San Matías Gulf, Río Negro province.

INFECTION SITES: Gonad and digestive gland, also foot and mantle in high intensities of infection.

PREVALENCE: 1/690 (0.14%).

MATERIAL DEPOSITED: MLP 6286, 6287; CNP- Par 29, 30.

REFERENCE: Gilardoni et al. (2011b).

***Postmonorcheides* Szidat, 1950**

***Postmonorcheides maclovini* Szidat, 1950 (New record)**

HOST: *Lasaea adansoni* (Gmelin) (Bivalvia: Lasaeidae).

HABITAT: Among byssi of mytilids or among cirripedians *Balanus* sp. (Balanidae), rocky intertidal.

CERCARIAN GROUP: Leptocercous.

LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITE: Gonad.

PREVALENCE: 18/648 (2.78%).

LIFE CYCLE: Same clam *L. adansoni* act as second intermediate host (metacercaria encyst inside sporocyst); mullet *Eleginops maclovinus* (Cuvier) (Eleginopidae) as definitive host.

MATERIAL DEPOSITED: CNP- Par 61 (cercaria), 62 (adult).

GENBANK NUMBER: KC920685 (sporocyst with cercariae and metacercariae), KC920684 (adult) (ITS1).

REFERENCE: Szidat (1950) (adult).

***Proctotrema* Odhner, 1911**

***Proctotrema bartolii* Carballo, Laurenti & Cremonte, 2011**

HOST: *Darina solenoides* (King) (Bivalvia: Mactridae).

HABITAT: Sandy intertidal.

CERCARIAN GROUP: Microcercous.

LOCALITIES: Fracasso Beach (FB) (42.42° S, 064.12° W), Colombo Beach (CBe) (42.60° S, 064.23° W), Chubut province; Punta Medanosa (PMe) (48.10° S, 065.90° W), Punta Loyola (PL) (51.63° S, 068.97° W), Santa Cruz province.

INFECTION SITES: Gonad, digestive gland, also gills in high intensities of infection.

PREVALENCES: 60/80 (75%)- 80/80 (100%) (FB), 15/15 (100%) (CBe), 15/15 (100%) (PMe), 15/15 (100%) (PL).

LIFE CYCLE ADVANCES: Same clam *D. solenoides* as second intermediate host (metacercariae encyst mainly in incurrent siphon); silversides *Odonthestes smitti* (Lahille) and *O. nigricans* (Richardson) (Pisces: Atherinopsidae) and mullet *Eleginops maclovinus* (Cuvier) (Eleginopidae) as definitive hosts.

MATERIAL DEPOSITED: CNP-PAR 2, 3, 4, 5 (FB).

REFERENCE: Gilardoni et al. (2013).

***Proctotrema* sp. (New record)**

HOST: *Gaimardia trapesina* (Lamarck) (Bivalvia: Gaimardiidae).

HABITAT: On fronds of the giant kelp *Macrocystis pyrifera* (Linnaeus) (Laminariaceae), shallow subtidal.

CERCARIAN GROUP: Microcercous.

LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad and digestive gland.

PREVALENCE: 8/692 (1.15%).

LIFE CYCLE ADVANCES: Same clam *G. trapesina* as second intermediate host (metacercaria encyst in foot); nototheniids *Patagonotothen cornucola* (Richardson) and *P. sima* (Richardson) (Nototheniidae) as definitive hosts.

MATERIAL DEPOSITED: CNP-PAR 42 (cercaria), 43 (metacercaria), 44 (adult).

GENBANK NUMBER: KP765717 (sporocyst), KP765716 (adult) (ITS1).

Notocotylidae Lühe, 1909

Notocotylidae gen. et sp. (New record)

HOST: *Nacella (Patinigera) magellanica* (Gmelin) (Gastropoda: Nacellidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Monostomate.

LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad and digestive gland.

PREVALENCE: 1/306 (0.33%).

MATERIAL DEPOSITED: CNP-PAR 57.

GENBANK NUMBER: KF656705 (metacercaria) (ITS1).

Philophtalmidae Looss, 1899

Parorchis Nicoll, 1907

Parorchis sp.

HOST: *Trophon geversianus* (Pallas) (Gastropoda: Muricidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Echinostome.

LOCALITIES: Fracasso Beach (FB) (42.42° S, 065.12° W), Puerto Madryn (PMD) (42.78° S, 065.02° W), Chubut province and Puerto Deseado (PD) (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad and digestive gland.

PREVALENCES: 17/427 (4%) (FB), 6/689 (0.87%) (PMD), 1/151 (0.66%) (PD).

LIFE CYCLE ADVANCES: Second intermediate host absent (cercaria encyst in the substrate); kelp gull *Larus dominicanus* and white-rumped sandpiper *Calidris fuscicollis* (Vieillot) (Scolopacidae) as definitive hosts.

MATERIAL DEPOSITED: MLP 6282 (PMD), CNP-PAR 24, 25 (cercaria) (PMD), 15 (adult) (FB).

GENBANK NUMBER: KF451927 (sporocyst) (PMD), KF451928, KF451929, KF451930 (adult) (PD) (ITS1, 5.8S, ITS2, 28S).

REFERENCES: Diaz et al. (2011); Gilardoni et al. (2011a).

Renicolidae Dollfus, 1939

Renicolidae gen. et sp. 1

HOST: *Trophon geversianus* (Pallas) (Gastropoda: Muricidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Xiphidiocercaria.

LOCALITIES: Fracasso Beach (FB) (42.42° S, 064.12° W), Puerto Madryn (PMD) (42.78° S, 065.02° W), Chubut province and Puerto Deseado (PD) (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad and digestive gland.

PREVALENCES: 2/427 (0.5%) (FB), 2/689 (0.29%) (PMD), 7/151 (4.64%) (PD).

LIFE CYCLE ADVANCES: Mussel *Mytilus edulis* as second intermediate host; kelp gull *Larus dominicanus* Lichtenstein (Laridae) as definitive host.

MATERIAL DEPOSITED: MLP 6278-6279 (PMD), CNP-PAR 20 (PMD).

GENBANK NUMBER: KF358774 (sporocyst) (PMD), KF425522 (metacercaria) (CR) (ITS1).

REFERENCES: Gilardoni et al. (2011a).

Renicolidae gen. et sp. 2 (New record)

HOST: *Nacella (Patinigera) magellanica* (Gmelin) (Gastropoda: Nacellidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Xiphidiocercaria.

LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITE: Digestive gland.

PREVALENCE: 3/306 (0.98%).

MATERIAL DEPOSITED: CNP-PAR 55.

GENBANK NUMBER: KF358775 (sporocyst) (ITS1).

Schistosomatidae Stiles & Hassall, 1898

Schistosomatidae gen. et sp.

HOST: *Siphonaria lessonii* Blainville (Gastropoda: Siphonariidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Distome furcocercous apharyngeate.

LOCALITIES: Fracasso Beach (FB) (42.42° S, 064.12° W), Comodoro Rivadavia (CR) (45.87° S, 067.48° W), Chubut province and Puerto Deseado (PD) (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad and digestive gland, mucous gland and in the vicinity of seminal vesicle.

PREVALENCES: 5/394 (1.3%) (PF), 6/500 (1.2%), 31/500 (6.1%) (CR), 1/186 (0.54%) (PD).

MATERIAL DEPOSITED: MLP 5737 (CR), CNP-PAR 56 (FB).

REFERENCES: Alda and Martorelli (2009).

Zoogonidae Odhner, 1902

Diptherostomum Stossich, 1903

***Diphterostomum brusinae* (Stossich, 1889)**

HOST: *Buccinanops globulosus* (Kiener) (Gastropoda: Nassariidae).

HABITAT: Sandy intertidal and subtidal.

CERCARIAN GROUP: Tailless xiphidiocercaria.

LOCALITIES: Fracasso Beach (FB) (42.42° S, 064.12° W), Puerto Madryn (PMD) (42.78° S, 065.02° W), Chubut province.

INFECTION SITES: Gonad and also digestive gland in high intensities of infection.

PREVALENCES: 9/430 (2.1%) (Intertidal sample) (FB), 3/59 (5.1%) (Subtidal sample) (PMD).

LIFE CYCLE ADVANCES: Same gastropod *B. globulosus* (metacercaria encyst inside sporocyst) and polychaete *Kinbergonuphis dorsalis* (Ehlers) (Onuphidae) as second intermediate host; reef fish *Pinguipes brasilianus* Cuvier (Pinguipedidae) as definitive host.

MATERIAL DEPOSITED: MLP 6280, 6281 (PMD); CNP-PAR 21, 23 (cercaria), 22 (metacercaria) (PMD).

GENBANK NUMBER: KF358772 (sporocyst), KF483875 (adult) (PMD) (ITS1, 5.8S, ITS2).

REFERENCES: Timi et al. (2008), Gilardon et al. (2011a).

Zoogonus* Looss, 1901**Zoogonus* sp. (New record)**

HOST: *Pareuthria plumbea* Philippi (Gastropoda: Buccinidae).

HABITAT: Rocky intertidal.

CERCARIAN GROUP: Tailless xiphidiocercaria.

LOCALITY: Puerto Deseado (47.75° S, 065.97° W), Santa Cruz province.

INFECTION SITES: Gonad and digestive gland.

PREVALENCE: 1/458 (0.22%).

MATERIAL DEPOSITED: CNP-PAR 54.

GENBANK NUMBER: KF358773 (sporocyst) (ITS1, 5.8S, ITS2).

DISCUSSION

This bibliographic survey, with new record, presents the diversity of marine digenean cercariae in molluscs from Argentine coast over 54 years of parasitological studies. A total of 31 cercariae were known to parasitize 20 species of molluscs; 14 of which parasitized nine gastropods species and 17 were parasitized 11 bivalve species.

However, the number of cercariae identified at generic (10) or specific level (6) is relatively small in comparison with a great number of adults digenean known (226) from vertebrates hosts, 125 from fish (e.g., Kohn et al. 2007; Braicovich and Timi 2008; Timi et al. 2008; Timi and Lanfranchi 2009), 95 from birds (e.g., Lunaschi et al. 2007; Diaz and Cremonte 2010) and six from marine mammals (e.g., Lunaschi et al. 2007). However, from Argentina, there are few species of molluscs recorded (20) with digenean larvae, despite that the diversity

of Argentine marine molluscs is high (849 species) (Miloslavich et al. 2011).

This study is the third checklist of marine larval trematodes from South America. The two previous checklists recorded marine and freshwater cercariae from Chile (Muñoz and Olmos 2008) and Brazil (Pinto and Melo 2013), and these includes records since 1980 and 1912, respectively. The Chilean checklist summarized 63 species of digeneans; nine of them are larval trematodes (sporocysts or rediae with cercariae) parasitizing seven molluscan species and five of them are from marine molluscs. About 500 digeneans are known in vertebrates from Brazil. From 46 larval trematodes species recorded in 25 molluscan species in Brazil, only five are marine. The records of larval trematodes from freshwater molluscs (at least 95 species) from Argentina are much higher (e.g., Ostrowski de Núñez 1992; Ostrowski de Núñez et al. 1997; Flores and Semenas 2008; Martorelli et al. 2013; Alda and Martorelli 2014), than Chile and Brazil. However, the number of records from marine molluscs is higher than Chile and Brazil (31 digenean species from 20 molluscs). We found 12 families, corresponding to Gymnophallidae, Monorchidae, Bucephalidae, Lepocreadiidae, Aporocotylidae, Microphallidae, Renicolidae, Zoogonidae, Fellodistomidae, Hemiuridae, Philophthalmidae and Schistosomatidae. From Chilean marine cercariae, two species belong to Fellodistomidae, one each to Bucephalidae, Gymnophallidae and Plagiorchiidae. From Brazilian marine cercariae, three species belong to Bucephalidae, one to Cyathocotylidae and one (*Cercaria maritima*) to an unidentified family.

Studies of larval digeneans are necessary to elucidate life cycles and to link cercariae to their respective adult parasites. Moreover, morphological descriptions should be complemented with molecular data, because the majority of larvae can only be identified to family by their morphologically. On the other hand, the distribution of records is not uniform throughout the country mainly because most studies were made in a few Patagonian localities. We hope that this review can stimulate new studies on marine larval digeneans and contribute to the biodiversity knowledge from South American marine parasites.

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